(12) **PATENT**
(19) **AUSTRALIAN PATENT OFFICE**

(11) Application No. **AU 200111200 B2**
(10) Patent No. **779604**

(54) Title
Building panel production method and apparatus

(51)[7] International Patent Classification(s)
B28B 023/02 **B28B 015/00**
B28B 001/30 **B28B 019/00**
B28B 005/02 **E04C 002/06**
B28B 005/04

(21) Application No: **200111200** (22) Application Date: **2000.11.03**

(87) WIPO No: **WO01/32380**

(30) Priority Data

(31) Number	(32) Date	(33) Country
PQ3840	**1999.11.03**	**AU**

(43) Publication Date : **2001.05.14**
(43) Publication Journal Date : **2001.07.26**
(44) Accepted Journal Date : **2005.02.03**

(71) Applicant(s)
Exin International Pty Ltd as Trustee for Exin IP Trust

(72) Inventor(s)
John Bartholomew Lee

(74) Agent/Attorney
Ahearn Fox,GPO Box 1149,BRISBANE QLD 4001

(56) Related Art
US 5961900
DERWENT ABSTRACT ACCESSION NO. 90-172378/23
DERWENT ABSTRACT ACCESSION NO. 91-196323/27

AU 200111200

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 May 2001 (10.05.2001)

PCT

(10) International Publication Number
WO 01/32380 A1

(51) International Patent Classification⁷: B28B 23/02, 19/00, 15/00, 1/30, 5/02, 5/04, E04C 2/06

(21) International Application Number: PCT/AU00/01347

(22) International Filing Date:
3 November 2000 (03.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PQ 3840 3 November 1999 (03.11.1999) AU

(71) Applicant *(for all designated States except US)*: EXIN INTERNATIONAL PTY LTD as trustee for Exin IP Trust [AU/AU]; 113 Akuna Street, Kenmore, Queensland 4069 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: LEE, John, Bartholomew [AU/AU]; 33 Akuna Street, Kenmore, QLD 4069 (AU).

(74) Agent: PIZZEYS PATENT & TRADE MARK ATTORNEYS; Level 11, Telstra House, 167 Eagle Street, Brisbane, QLD 4000 (AU).

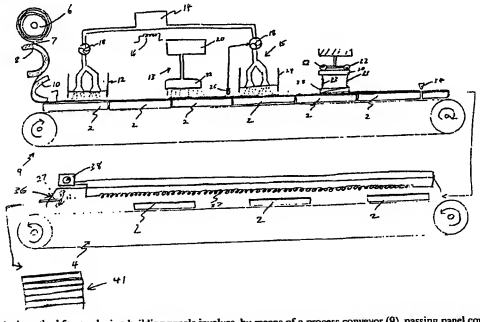
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BUILDING PANEL PRODUCTION METHOD AND APPARATUS



(57) Abstract: A method for producing building panels involves, by means of a process conveyor (9), passing panel cores (2) and adjacent mesh (7) beneath a number of processing stations (12, 13, 15) in order to bond the mesh to the core by means of a cementitious coating. Subsequently the panels are passed to a drying conveyor (4) including a heater (36) for drying of the coating.

WO 01/32380 A1

BUILDING PANEL PRODUCTION METHOD AND APPARATUS

Field of Invention

This invention relates to methods of, and an apparatus for, producing building panels.

Background to the Invention

There are a limited number of panel types which are in widespread use throughout the building industry. Typically the building panels include plywood panels and plasterboard panels which are extensively used internally and fibre-board sheets which are used extensively for internal and external applications, whether as panels, tiles or simulated boards.

The production of such fibre-based sheets requires large expensive plant and thus production is often centralised. Furthermore, such production facilities are cost limited to the production of a limited number of styles and sheet variations.

The present invention has been devised with the object of providing a method of producing a building panel that overcomes, or at least amelioriates, the above problems.

Summary of the Invention

With the foregoing in view, this invention in one aspect resides broadly in a method of forming a building panel including:

conveying a panel former having opposed faces through processing stations at a substantially horizontal attitude such that one of the faces is present as an upper face;

feeding a flexible reinforcing material with the panel former into operative alignment with the upper face;

applying a liquid ingredient directly to the upper face of the panel former so as to thoroughly wet the upper face of the former and the reinforcing material operatively aligned therewith;

depositing a sand/cement mixture on the upper face of the panel;

mixing the liquid ingredients and the sand/cement mixture to form cement based coating ingredients; and

spreading the cement based coating ingredients to form a coating on the upper face of the panel former.

The flexible reinforcing material is suitably an open weave fibreglass mesh but it could be an open steel mesh if required such as steel mesh which is used to form screens and the like.

The cement based coating ingredients may include a dry sand/cement mixture suitably in the ratio of 2 parts of sand to 1 part cement.

The liquid suitably includes a bonding agent such as an acrylic or latex solution that is water soluble solution and which can be mixed with water to provide the liquid agent for mixing with the cement product to provide the finished cement based coating.

Preferably the dry sand/cement mixture includes an accelerant in order to hasten curing of the coating. Cement accelerants are well known, for example they are used in quick-set cement mixtures which are commercially available. The dry mix preferably contains one of a number of admixtures to either accelerate or retard curing time as required.

Suitably the liquid portion of the mix is applied directly to the surface of the panel former so as to thoroughly wet the surface of the former and the reinforcing material supported thereon and suitably the liquid is applied in such a quantity as to be retained on the panel former in a substantially even coating.

Damming means may be provided for this purpose but suitable location of the flexible reinforcing material on the panel former causes the liquid to be retained in the appropriate distribution over the panel former. The cementitious component of the cement based coating ingredients are suitably added subsequent to the liquid by distribution means which distributes a constant volume of the powder evenly across the wet surface of the panel former.

A second liquid portion of mix may be provided subsequent to and on the surface of the powder in order to increase the ease of mixing of the ingredients.

Preferably mixing of the cementitious component with the liquid component is achieved by spreading means adapted to spread the coating evenly across the upper surface of the panel former. However, the mixing and the spreading steps can be performed independently if required. Alternatively, premixed cement based coating product may be introduced on to the panel former and spread thereacross and through the flexible reinforcing material by suitable spreading means.

It is preferred that the thickness of any cement based coating be maintained in the order of 1mm to 2mm and that each layer be allowed to at least partially cure prior to addition of further layer. Suitably where thicker coatings are required, they are built up by a series of laminations applied in several passes through the processing apparatus. The panel former may be a structural member such as a core or backing.

It may be used as a core between layers formed of the cement based coating applied thereto in the process of this invention and suitably in successive operations on the same or adjacent machines. Alternatively the panel former may serve purely as a former for a cement based coating panel to be built up as described above to a desired thickness so that the formed coating layer achieves the structural properties required. Then again, a relative rigid core such as a polystyrene or polyurethane core may be utilised with a cement based coating on one side as a insulated building panel. A fire resistant foam core may be utilised as may other conventional core materials such as balsa or plywood.

Preferably the panels comprising panel core and mixed coating with flexible reinforcing material are passed along a drying conveyor in order that a skin forms on the coating sufficient to allow stacking of panels.

According to a further aspect of the present invention there is provided an apparatus for producing a building panel including:

a conveyor for conveying panel cores;

a mesh feed for feeding mesh over the panel cores on the conveyor;

a number of processing stations located along the conveyor for applying a coating for bonding the mesh to the panel core.

Preferably the processing stations include:

a liquid ingredient station arranged to supply a liquid ingredient of the coating;

a dry ingredient station arranged to supply a dry ingredient of the coating;

a screeding station arranged to smooth the coating.

The apparatus may further include a drying station for drying the coating.

In a preferred embodiment the apparatus includes a second drying conveyor having with the drying station located adjacent it and arranged to dry the coating.

Preferably the apparatus further includes a second liquid ingredient station and a second dry ingredient station.

In order to provide a smooth finish it is desirable that the screeding station is arranged to apply both vibrational and orbital forces by means of a datum surface of the screeding station to the coating.

The above method and apparatus is suited to forming a bullet-proof panel comprised of layers of laminated panels including a bottom panel layer having its upper face laminated using a steel mesh as reinforcing and further laminated panels formed using a fabric mesh reinforcing. In use the top three panels operate to capture the bullet and reduce its velocity so that it may be halted by the steel reinforced layer.

Brief Description of Figures

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrates a typical preferred embodiments of the invention and wherein:

Figure 1 is a schematic diagram of a production line process according to an embodiment of the present invention.

Figure 2 is a schematic diagram of a bullet-proof layer which may be produced by the production line process of Figure 1.

Detailed Description of Preferred Embodiment

In order that this invention may be more readily understood and put into practical effect, reference will now be made to a typical application of the present invention.

With reference to Figure 1, a process conveyor 9 accepts rectangular core sheets 2 in end abutting relationship and conveys them in end to end relationship through processing stations, to be described, and onto a drying conveyor 4. The rectangular core sheets may be of any of the types previously described.

At the entry end of the process conveyor coarse fibreglass mesh stored in an overhead roll 6 is fed over a curved upper guide surface 8 down to the underside of an oppositely curved lower guide 10 which leads the mesh onto the surface of a core panel 2. The mesh is operatively secured to a leading panel by the mixed ingredients or its leading end is adhered to the first panel to commence the continuous coating operations.

The mesh sits freely on top of the panels where it is stretched to its operative configuration by being anchored to advancing panels which have been coated and by maintaining a slight but sufficient lead-off tension from the roll.

The mesh is bonded on to the panel with the wet cement based coating product sufficiently to continuously draw it from the spool and feed it onto the subsequent panels.

A joining station, not shown, may be provided at the leading edge of the process conveyor to enable overlapped joints to be formed by pressure and heat welded or bonded together. .

At the first wetting station 12 liquid additive is added through two spray bars held in a booth which limits the spray pattern to a rectangular zone directly above the panel conveyor.

In use, a panel core supported on the conveyor has the mesh stretched across its upper surface with the result that the liquid additive puddles up or is restrained in the mesh itself substantially evenly across the core to ensure that the desired quantity of liquid additive is provided for the cement/sand mixture.

Applying the liquid additive directly to the core not only provides the desired quantity of liquid additive for the mixture, it also wets the surface of the panel. Consequently when the cement based coating mixture produced by mixing the liquid additive with the dry cement/sand mixture is prepared, the surface onto which it is deposited is thoroughly wet to ensure very good adhesion to the core.

The liquid additive is suitably a 50/50 acrylic/water mixture stored in a tank 14 and heated by heater 16 to about 50°C and then pumped by means of pump 18 to the wetting stations as required. Heating of the liquid additive facilitates curing of the coating. The liquid is applied at about 40°C. The liquid may be heated to higher than 50°C to overcome losses in the transit from the pump to the applicator if desired.

The second station 13 provides a hopper 20 for the sand/cement mix and a distribution head 22 which continuously sprinkles an even layer of the dry mixture over the advancing wet surface of the conveyor supported core 2. The mixture falls into the liquid additive constrained substantially evenly on by the core surface by the reinforcing mesh.

The third station 15 provides a further wetting bay 24 where additional liquid can be added if required. Suitably this station is process controlled such as by suitable monitoring means 26 or by an operator.

When the core exits the third station the correct amount of sand/cement mixture and liquid additive are present to provide the desired measure of ingredients to effect formation of a thin cement based coating layer which barely encapsulates the reinforcing mesh. Typically the formed layer will be in the order of 1mm to 1.5mm thick.

The second and third stations may be repeated one or more times if desired in order to generate a greater coating thickness.

At the fourth station the applied ingredients pass beneath an elongate screeding head 28 which extends angularly across the conveyor path at about 15°. The screeding head has a ramped lead-in wall which terminates inwardly of the edges of the panel and forwardly and outwardly extending wing portions which extend therefrom to the outer edges of the panel.

These wing portions gather any excess material toward the centre of the panel and prevent spillage and wastage of material over the edges thereof. This configuration also assists, in use, in the maintenance of a puddle at the leading face of the screeding head to ensure full and effective coverage of the mesh.

The screeding head has a flat datum surface extending rearwardly from the lead-in wall and a series of blades, the first of which is vertical followed by inclined trailing blades which incline downwardly in the direction of motion. The screeding head is suspended resiliently on springs 33 so it can be moved freely up and down and it is operatively positioned by its own weight. Its position is adjustable to enable the datum surface and the trailing blades to be set up as required and level across the panel at the desired distance above the panel.

The screeding head is suspended from a cross-bar 30 which is driven for orbital motion about laterally spaced vertical support axles (not shown) arranged at each end of the cross bar. Vibrators 32 are mounted directly on the screed head so as to impart vibration thereto. In one form the vibrators are pneumatically driven at a relatively fairly high frequency. The screeding blades are adjusted so that they are just in contact with the mesh supported by the core panel. In use, an orbital motion of the resiliently suspended screeding head together with its vibrating motion effects mixing of the ingredients as well as levelling of the wet cement based coating mixture across the panel.

Alternatively the screeding head may be implemented as two stations. An initial fourth station consisting of a number of timber blades approximately 20-25mm wide and with gaps in their long dimension of approximately 15mm at 150mm spacing. This alternative fourth station is then followed by a fifth station comprising a flat substantially horizontal blade which acts as a final thickness control.

A cutter 34 is disposed about one panel length beyond the screeding station to sever the mesh and wet cement based coating mixture along the abutting edges of adjacent panels. Each coated panel is then advanced by its process conveyor to a drying conveyor 4 which is configured to travel at about twice the speed of the process conveyor so as to distance the separated panel from the next separated panel on the drying conveyor. This will facilitate unloading at the end of the drying conveyor at which the mixture is partly cured and is touch dry.

Suitably a drying chamber 36 in which blown air is heated to about 50°C is arranged about the drying conveyor to facilitate quick reaction and curing of the mixed ingredients. Fan 27 and heating element 37, under control of temperature adjustable thermostat 38 is provided for this purpose. The drying chamber is arranged so that upon exiting the drying conveyor the coating has formed a skin sufficient to allow panels from the drying conveyor to be stacked one above the other, for example in stack 41, without adhering to each other. The panels with partially cured coatings can then be left for sufficient time, for example overnight, until curing is complete.

The operation of the various stations may be coordinated under a centralised computerised control. Alternatively a human operator may be responsible for controlling each of the stations.

The panels are suitably offloaded onto a mobile tilt table on which they are moved to a stack of panels ready to be left for final curing before being returned to the processing stations for coating the other side of the panel if a coating is required on both sides or stacked if the panels have completed a second side coating run. Alternatively the coated panels may be returned to a apply further coating to the same side of the panel so as to build up the thickness of the cement based coating or provide a finishing coat as will be described below.

Typically the process conveyor operates at about seven to ten metres per minute and the process conveyor is about eighteen metres long.

The drying conveyor is suitably U-shaped so that it returns to adjacent the input end of the process conveyor. The total length of the drying conveyor is about 65 metres to give a holding time thereon of about six to seven minutes.

Typically the panels are put through and coated either side and depending on customer requirements, the panel can be finish coated.

Panels are finish coated by putting them through the previously described process, though without repeated application of mesh 7. During the finishing run dry ingredient is fed applied at the same rate as previously and built up in the number of layers required to get the desired finish so that the machine change of settings are not necessary. In the finish coat, more liquid additive is added to get a more puddling effect for achieving a flat surface on the finish.

Various surface finishes may be achieved. For example the panel may be re-coated with the cement based coating mixture without reinforcing mesh and without screeding. This will provide a random pattern texture to the surface. Alternatively the panels may be coated with a plaster mix and pass through a sanding station for smooth finishing. Then again, multiple layers of reinforced cement based coating may be applied to one or more sides of the panel to achieve the desired thickness panel.

These operations may require adjustment to the screeding head between applications, however the one machine, which is a relatively low cost machine, may be utilised to produce many different laminations. Thus local production of various panel types is very viable using the apparatus and methods of the present invention.

One specialised panel which may be formed is a bullet proof panel. This may include layers 47 of laminated polystyrene foam cored panels including a bottom panel layer having its upper face laminated using a steel mesh 49 as the reinforcing and further laminated panels formed using a fabric mesh reinforcing 51. In one embodiment the wall could be formed from four laminated layers each having a foam core of 15mm thick covered with a reinforced cement based coating of 3mm thick, achieved in two coating procedures in which a 1.5mm thick coating is applied. The top three panels are intended to capture the bullet and slow it down so that it is stopped by the steel reinforced layer.

It is further envisaged that the steel reinforcing mesh will protrude beyond the edges of the panels so that adjacent panels can be positively tied together by joining together overlapped mesh protrusions. The resultant gaps between joined panels may then be filled with a suitable filler.

It will of course be realised that the above has been given by way of illustrative example of the invention only and that all such modifications and variations thereto as would be made thereto by persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as set forth in the following claims.

The claims defining the invention are as follows:

1. A method of forming a building panel including:

conveying a panel former having opposed faces through processing stations at a substantially horizontal attitude such that one of the faces is presented as an upper face;

feeding a flexible reinforcing material with the panel former into operative alignment with the upper face;

applying a liquid ingredient directly to the upper face of the panel former so as to thoroughly wet the upper face of the former and the reinforcing material operatively aligned therewith;

depositing a sand/cement mixture on the upper face of the panel;

mixing the liquid ingredients and the sand/cement mixture to form cement based coating ingredients;

spreading the cement based coating ingredients to form a coating on the upper face of the panel former.

2. A method according to Claim 1, wherein the sand/cement mixture is distributed evenly across the upper face of the panel former.

3. A method according to claim 1 or Claim 2, wherein the sand/cement mixture is in the ratio of 2 parts sand to 1 part cement by weight.

4. A method according to any one of Claims 1 to 3, wherein the liquid ingredient includes a bonding agent in the form of an acrylic solution.

5. A method according to any one of Claims 1 to 3, wherein the liquid ingredient includes a bonding agent in the form of a latex solution.

6. A method according to any one of the preceding claims, wherein the liquid is applied in such a quantity as to be retained on the panel former in a substantially even coating.

7. A method according to any one of the preceding claims, including retaining the liquid on the panel in a substantially even coating by providing damming means in operative disposition with respect to the upper face of the panel former.

8. A method according to any one of the preceding claims, wherein mixing of the sand/cement mixture with the liquid ingredient is achieved by spreading the coating evenly across the upper surface of the panel former.

9. A method according to claim 8, wherein mixing and spreading steps for mixing the sand/cement mixture with the liquid ingredient and spreading a resulting mixture evenly across the upper surface are performed separately.

10. A method according to any one of the preceding claims, wherein the thickness of the coating is maintained in the order of 1mm to 2mm.

11. A method according to any one of the preceding claims, wherein a plurality of layers are applied.

12. A method according to Claim 11, wherein each coating layer is at least partially cured prior to addition of a further layer.

13. An apparatus for producing a building panel including:

a conveyor for conveying panel cores in a substantially horizontal disposition;

a mesh feed for feeding mesh over the panel cores on the conveyor;

a plurality of processing stations located along the conveyor for applying a cement based mixture for bonding the mesh to the panel core, the processing stations including:

a liquid ingredient station arranged to supply a liquid ingredient of the coating mixture;

a dry ingredient station downstream from the liquid ingredient station arranged to supply a dry ingredient of the coating mixture;

a screeding station downstream from the dry ingredient station arranged to mix the liquid and dry ingredients to form a cement based coating and smooth the coating mixture.

14. An apparatus according to claim 13, further including a drying station for drying the coating.

15. An apparatus according to claim 14, further including a second drying conveyor having a drying station located adjacent thereto arranged to dry the coating.

16. An apparatus according to any one of Claims 13 to 15, and further including a second liquid ingredient station and a second dry ingredient station.

17. An apparatus according to any one of Claims 13 to 16, wherein the screeding station is arranged to apply both vibrational and orbital forces by means of a datum surface to the coating.

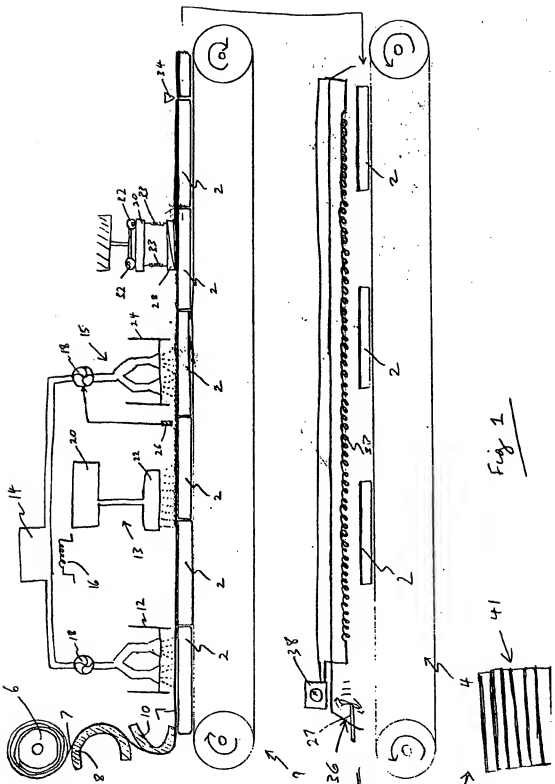


Fig 1

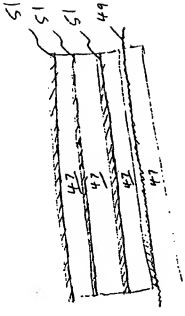


Fig 2